

ORIGINAL ARTICLE

Three new species of eriophyid mites from Wanglang Nature Reserve, Sichuan, China (Acari: Eriophyidae)

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Abstract Three new species of eriophyoid mites from Wanglang Nature Reserve, Sichuan Province, China are described and illustrated, namely *Aculops loniceris* sp. nov. infesting *Lonicera* sp. (Caprifoliaceae), *Aculus hypoleus* sp. nov. infesting *Maddenia hypoleuca* Koehne (Rosaceae), and *Anthocoptes lindleyanus* sp. nov. infesting *Buddleja lindleyana* Fortune and *Buddleja davidii* Franch. (Scrophulariaceae). All new species described here are vagrants on the undersurfaces of leaves of their host plants.

Key words Eriophyoidea, Phyllocoptine, taxonomy, new species, Sichuan Province.

1 Introduction

Sichuan Province lies in southwestern China, where the landform is varied, including the Qinghai-Tibet Plateau, Hengduan Mountains, Yunnan-Guizhou Plateau, Qinba Mountains and Sichuan Basin. Following with the elevation from 400 m to 5000 m, the climate and the plants are changed with different terrain. About ten thousand species plants are distributed in Sichuan (Li & Zhang, 2002). Until 2017, only five species of eriophyoid mites have been reported in Sichuan Province, namely, *Aceria granti* (Canestrini & Massalongo, 1894), *Aceria sheldoni chinensis* Kuang & Hong, 1991, *Shevtchenkella humulus* Wei & Qin, 2002, *Phyllocoptrus oleivora* (Ashmead, 1879) and *Aculus ligustri* (Keifer, 1938).

Wanglang Nature Reserve lies in Pingwu County, Sichuan, China, where the giant panda and other rare animals and the forest ecosystem are protected. In 2016, a field survey for insects is conducted in Wanglang Nature Reserve. A few eriophyid mites specimens are collected by the author from leaves of wild plants in the survey. Herein, three new species viz., *Aculops loniceris* sp. nov. infesting *Lonicera* sp., *Aculus hypoleus* sp. nov. infesting *Maddenia hypoleuca* and *Anthocoptes lindleyanus* sp. nov. infesting *Buddleja lindleyana* are described and illustrated.

The genera *Aculops*, *Aculus* and *Anthocoptes* are under the tribe *Anthocoptini* Amrine & Stasny, 1994 (Eriophyoidea: Eriophyidae: Phyllocoptine) by the scapular setae (sc) on rear margin of prodorsal shield and projecting to rear. They are widespread, and including 177 species in *Aculops* (39 from China), 279 species in *Aculus* (50 from China) and 53 species in *Anthocoptes* (5 from China) (Amrine & Stasny, 1994; Amrine *et al.*, 2003; Hong *et al.*, 2010; Song *et al.*, 2011; Xie *et al.*, 2013; Xie, 2014; Gu *et al.* 2015; Dong *et al.*, 2016).

2 Materials and methods

All specimens were collected from Wanglang Nature Reserve (Pingwu County, Sichuan, China) during August, 2016. The mites were collected, cleared and mounted on glass slides according to Kuang (1995). Specimens were measured following de Lillo *et al.* (2010). Morphological terminology and generic classification follow Amrine *et al.* (2003).

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Specimens were examined with an Olympus microscope (BX51) and made digital images by a CCD. All measurements are in micrometers (μm) and are lengths when not specified. The range of the paratypes (in brackets) follows the measurements of the holotype. All illustrations were prepared with the software Adobe Photoshop CS 8.0®. Type specimens are deposited presently in the Laboratory of Plant Protection, School of Modern Agriculture and Biotechnology, Ankang University, Ankang, Shaanxi, China.

3 Results

Eriophyoidea Nalepa, 1898

Eriophyidae Nalepa, 1898

Phyllocoptine Nalepa, 1892

Anthocoptini Amrine & Stasny, 1994

Aculops loniceris sp. nov. (Figs 1–6)

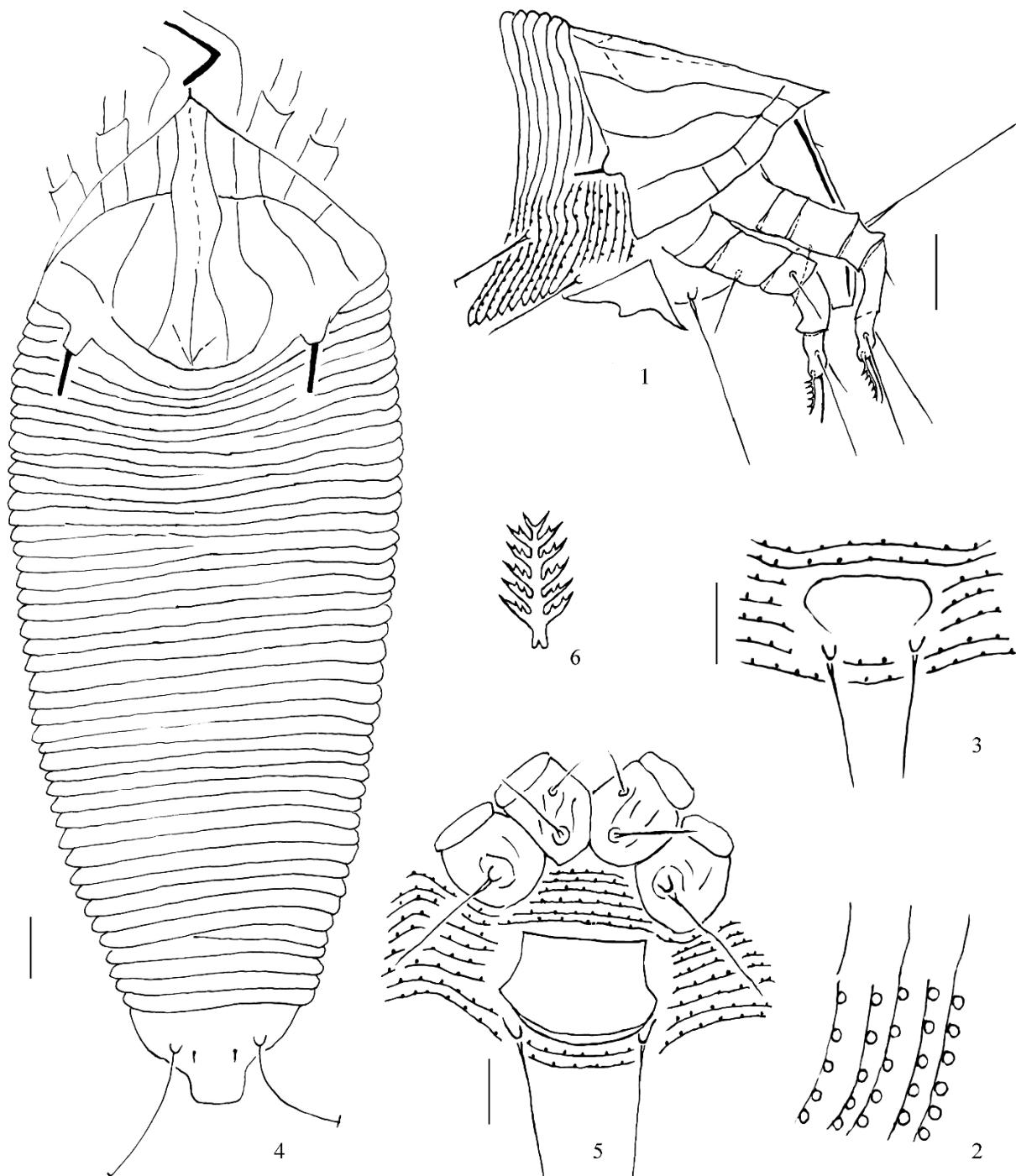
Diagnosis. Body fusiform, color light yellowish. Gnathosoma strong and projecting obliquely downward. Prodorsal shield triangular with a very acute frontal lobe over rostrum base, and getting a thorn addition on the tip of front lobe. Median line present with longitudinal dash at anterior 2/3, admedian lines complete, sinuate, and the first submedian lines completed and connecting with an arc line just ahead of rear margin. A transverse line just behind frontal lobe meeting with admedian and submedian lines at anterior shield 1/3. Scapular tubercles on rear shield margin, scapular setae (*sc*) directing to rear. Coxisternal plates with a few lines, prosternal apodeme present. Legs with tarsal empodium simple, 6-rayed, tarsal solenidion unknobbed. Opisthosoma with 39–43 dorsal annuli and 67–70 ventral annuli, dorsal annuli smooth. Female genitalia coverflap smooth.

Description. Female ($n=7$). Body fusiform, 170 (105–170), 70 (46–70) wide, 50 (45–50) thick; light yellowish in color. Gnathosoma 29 (26–29), strong, and projecting obliquely down; dorsal pedipalp genual setae (*d*) 6 (5–6), pedipala coxal setae (*ep*) 3 (2–3). Prodorsal shield triangular, 36 (35–40), 53 (42–53) wide, with a very acute frontal lobe over gnathosoma base, and a thorn on the tip of front lobe. Shield design of strong lines: Median line present with longitudinal dash at anterior 2/3, admedian lines complete, sinuate, the first submedian lines completed and connecting with an arc line just ahead of rear margin. A cross line just behind frontal lobe meeting with admedian and submedian lines at anterior shield 1/3. Scapular tubercles on rear shield margin, 36 (28–36) apart; scapular setae (*sc*) 7 (6–8), projecting to rear. Coxigenital region with 6 (4–6) microtuberculated semiannuli. Coxal plates sculptured with a few lines, anterolateral setae on coxisternum I (*1b*) 6 (5–6), 12 (7–12) apart; proximal setae on coxisternum I (*1a*) 13 (12–15), 6 (5–6) apart; proximal setae on coxisternum II (*2a*) 20 (20–28), 22 (18–22) apart; prosternal apodeme 6 (5–6). Leg I 35 (32–38), trochanter 3 (2–3), femur 10 (10–12), basiventral femoral setae (*bv*) 8 (8–10); genu 4 (4–5), antaxial genual setae (*l'*) 28 (25–28); tibia 10 (9–10), paraxial tibial setae (*l'*) 5 (4–5), located 1/3 from dorsal base; tarsus 8 (7–8), both setae *ft'* and setae *ft''* 18 (15–20); tarsal empodium (*em*) 7 (6–7), entire, 6-rayed; tarsal solenidion (*ω*) 8 (7–8), unknobbed. Leg II 31 (28–34), trochanter 3 (2–3), femur 10 (10–12), basiventral femoral setae (*bv*) 10 (10–12); genu 4 (3–4), antaxial genual setae (*l'*) 10 (10–12); tibia 7 (7–8); tarsus 7 (6–7), setae *ft'* 7 (5–7), setae *ft''* 18 (15–20); tarsal empodium (*em*) 7 (6–7), entire, 6-rayed; tarsal solenidion (*ω*) 8 (7–8), unknobbed. Opisthosoma with 42 (39–43) dorsal annuli, smooth; ventrally with 67 (65–70) semiannuli, with round microtubercles on rear annular margins except 5–6 ventral annuli with elongated microtubercles. Setae *c2* 35 (35–40) on ventral annulus 13–14, 42 (30–42) apart; setae *d* 30 (25–30) on ventral annulus 28–29, 31 (21–31) apart; setae *e* 37 (35–40) on ventral annulus 44–45, 18 (12–18) apart; setae *f* 32 (30–34) on 5th ventral annulus from rear, 23 (13–23) apart. Setae *h1* 2 (2), 6 (5–6) apart; setae *h2* 60 (60–70), 12 (10–12) apart. Female genitalia 17 (15–17), 25 (17–25) wide, coverflap smooth, setae *3a* 20 (15–20), 17 (12–17) apart.

Male ($n=1$). Body fusiform, 120, 45 wide; light yellowish in color. Gnathosoma 22, strong, and projecting obliquely downwards; dorsal pedipalp genual seta (*d*) 5. Prodorsal shield triangular, 45, 45 wide, with a very acute frontal lobe over rostrum base, and getting a thorn addition on the tip of front lobe. Shield design as female. Scapular tubercles on rear shield margin, 30 apart; scapular setae (*sc*) 7, projecting to rear. Coxigenital region with 3–4 microtuberculated semiannuli. Coxal plates sculptured with a few lines, anterolateral setae on coxisternum I (*1b*) 4, 9 apart; proximal setae on coxisternum I (*1a*) 13, 5 apart; proximal setae on coxisternum II (*2a*) 20, 15 apart; prosternal apodeme 6. Leg I 30, trochanter 2, femur 10, basiventral femoral seta (*bv*) 8; genu 4, antaxial genual seta (*l'*) 25; tibia 7, paraxial tibial seta (*l'*) 3, located 1/3 from dorsal base; tarsus 7, both setae *ft'* and setae *ft''* 20; tarsal empodium (*em*) 7, entire, 6-rayed; tarsal solenidion (*ω*) 8, unknobbed.

Leg II 29, trochanter 2, femur 10, basiventral femoral seta (*bv*) 10; genu 4, antaxial genual seta (*l''*) 10; tibia 6; tarsus 7, setae *ft'* 5, setae *ft''* 20; tarsal empodium (*em*) 7, entire, 6-rayed; tarsal solenidion (*ω*) 8, unknobbed. Opisthosoma with 42 dorsal annuli, smooth; ventrally with 60 semiannuli, with round microtubercles on rear annular margins except caudal 5–6 ventral annuli with elongated microtubercles. Setae *c2* 23 on ventral annulus 10–11, 28 apart; setae *d* 30 on ventral annulus 22–23, 22 apart; setae *e* 28 on ventral annulus 39–40, 10 apart; setae *f* 26 on 5th ventral annulus from rear, 17 apart. Setae *h1* 2, 4 apart; setae *h2* 50, 10 apart. Male genitalia 15 wide, setae *3a* 15, 10 apart.

Material examined. Holotype, female, from *Lonicera* sp. (Caprifoliaceae), Wanglang Nature Reserve (33°00'01"N, 104°02'02"E; elev. 2836m), Pingwu County, Sichuan, China, 15 August 2016, coll. Manchao Xie. Paratypes. 6 females and 1 male, the same data as holotype.



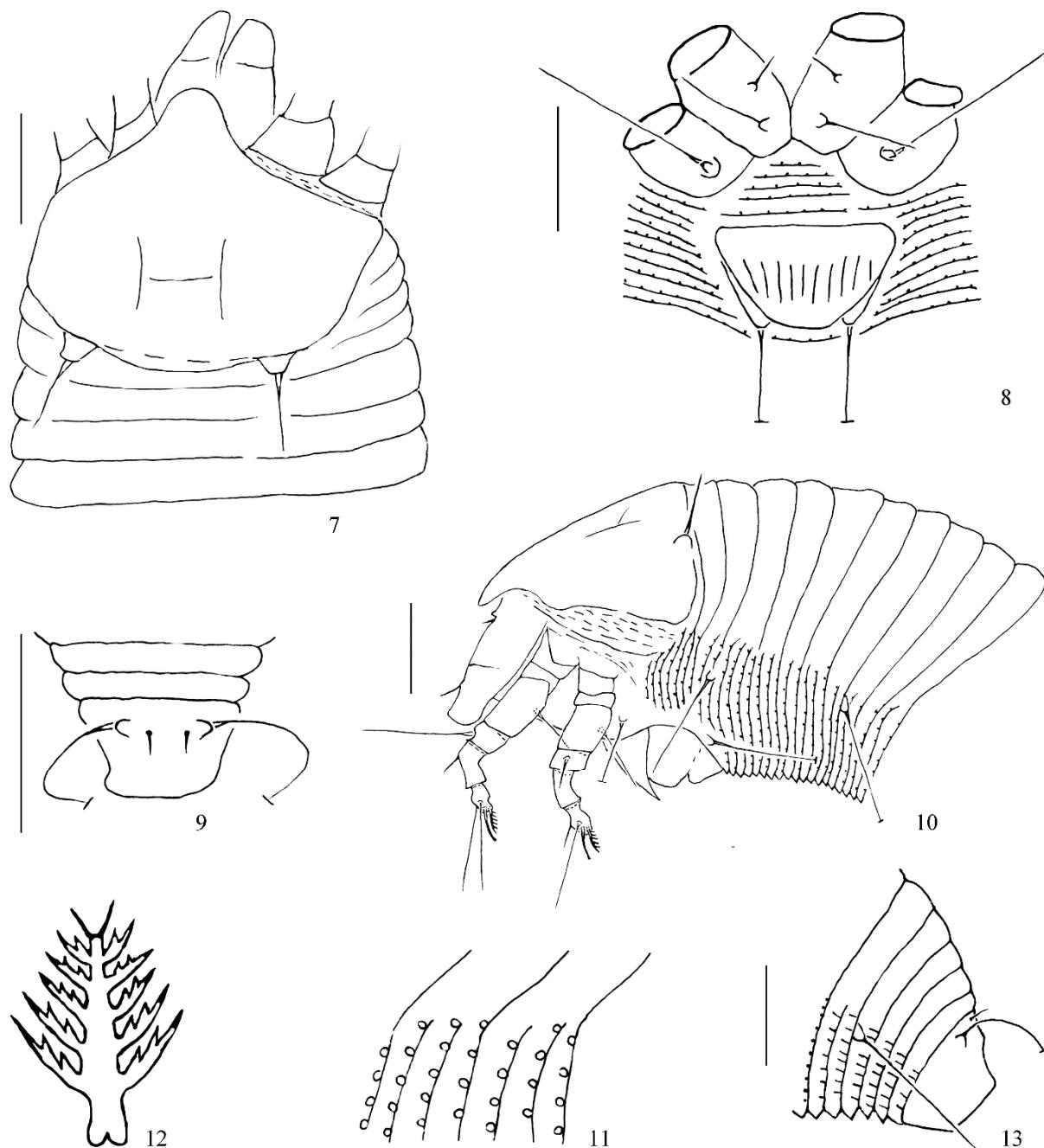
Figures 1–6. *Aculops loniceris* sp. nov., female. 1. Antero-lateral view. 2. Lateral opisthosoma (enlarged). 3. Genital region of male. 4. Dorsal view. 5. Coxal-genital region. 6. Empodium (enlarged). Scale bars: 1, 3–5 = 10 μ m.

Relation to host. The mites are vagrants on the undersurfaces of the leaves, no obvious damage seen.

Etymology. The specific name is from the Latin *lonicer* and *is*, *lonicer* is derived from the generic name of the host plant, and *is* does for masculine gender end.

Remarks. This new species is firstly reported on *Lonicera* spp. for the genus *Aculops*. The species is similar to *A. ulmi* Hong & Xue, 2005 and *A. ailanthi* Lin, Jin & Kuang, 1997 in the shield design pattern and the smooth coverflap of female genitalia. But it can be differentiated from them by the opisthosoma with dorsal annuli smooth, and the tarsal empodium 6-rayed (the dorsal annuli sculptured with microtuberculate spiny and the tarsal empodium 2-rayed in *A. ulmi*; the dorsal annuli sculptured with microtuberculates and the tarsal empodium 5-rayed in *A. ailanthi*). Moreover, the new species can also be differentiated from *A. ailanthi* by the prodorsal shield design without nets (shield design with close nets in *A. ailanthi*).

Additionally, the new species looks like the member of *Rhyncaphytoptus* by having a fairly strong gnathosoma projecting somewhat straight down, except the small, sharp anterior shield lobe over gnathosoma base and scapular setae (sc) projecting to rear.



Figures 7–13. *Aculus hypoleus* sp. nov., female. 7. Antero-dorsal view. 8. Coxal-genital region. 9. Caudal opisthosoma. 10. Antero-lateral view. 11. Lateral opisthosoma (enlarged). 12. Empodium (enlarged). 13. Postero-lateral view. Scale bars: 7–10, 13=20 μ m.

***Aculus hypoleus* sp. nov.** (Figs 7–13)

Diagnosis. Body fusiform, light yellowish in color. Gnathosoma projecting obliquely down. Prodorsal shield with a rounded frontal lobe over gnathosoma base. Shield design with H-shaped mark just ahead of rear margin. Scapular tubercles on rear shield margin, scapular setae (sc) directing to rear. Coxisternal plates smooth, prosternal apodeme present. Legs with tarsal empodium simple, 6-rayed, tarsal solenidion knobbed slightly. Opisthosoma with 23–26 dorsal annuli and 58–60 ventral annuli, dorsal annuli smooth. Female genitalia coverflap with 10 longitudinal ridges, setae 3a 40–50.

Description. Female ($n=9$). Body fusiform, 180 (150–200), 70 (70) wide, 65 (65–70) thick; light yellowish in color. Gnathosoma 23 (23), projecting obliquely downwards; dorsal pedipalp genual setae (d) 6 (6–7), pedipala coxal setae (ep) 3 (2–3). Prodorsal shield subelliptical, 43 (41–48), 60 (60–67) wide, with a rounded frontal lobe over gnathosoma base. Shield design with a H-shaped mark just ahead of rear margin. Scapular tubercles on rear shield margin, 30 (28–30) apart; scapular setae (sc) 13 (13–15), projecting to rear. Coxigenital region with 5 (4–6) microtuberculated semiannuli. Coxal plates smooth, anterolateral setae on coxisternum I (1b) 5 (4–5), 12 (10–12) apart; proximal setae on coxisternum I (1a) 15 (15–18), 6 (6–8) apart; proximal setae on coxisternum II (2a) 30 (27–35), 26 (25–26) apart; prosternal apodeme 5 (5). Leg I 35 (31–36), trochanter 2 (2–3), femur 11 (10–11), basiventral femoral setae (bv) 13 (10–13); genu 5 (5), antaxial genual setae (l') 25 (22–25); tibia 10 (8–10), paraxial tibial setae (l') 5 (5–7), located 1/3 from dorsal base; tarsus 7 (6–7), both setae f_1' and setae f_2' 20 (20–22); tarsal empodium (em) 6 (5–6), entire, 6-rayed; tarsal solenidion (ω) 7 (6–7), knobbed slightly. Leg II 32 (29–33), trochanter 2 (2–3), femur 11 (10–11), basiventral femoral setae (bv) 15 (11–15); genu 5 (5), antaxial genual setae (l') 8 (7–8); tibia 7 (6–7); tarsus 7 (6–7), setae f_1' 7 (5–7), setae f_2' 20 (20–22); tarsal empodium (em) 6 (5–6), entire, 6-rayed; tarsal solenidion (ω) 7 (6–7), knobbed slightly. Opisthosoma with 24 (23–26) dorsal annuli, smooth; ventrally with 58 (56–70) semiannuli, with round microtubercles on rear annular margins except 5–6 ventral annuli with elongated microtubercles. Setae c2 23 (17–25) on ventral annulus 8–9, 53 (48–55) apart; setae d 40 (40–45) on ventral annulus 23–24, 32 (25–32) apart; setae e 15 (13–15) on ventral annulus 39–40, 15 (13–15) apart; setae f 20 (20–23) on 5th ventral annulus from rear, 20 (18–21) apart. Setae h1 3 (3), 5 (5) apart; setae h2 60 (60–70), 8 (8) apart. Female genitalia 16 (16–18), 24 (22–26) wide, coverflap sculptured with 10 longitudinal ridges, setae 3a 40 (40–50), 13 (12–13) apart.

Male. Unknown.

Material examined. Holotype, female, from *Maddenia hypoleuca* Koehne (Rosaceae), Wanglang Nature Reserve (32°54'47"N, 104°09'17"E; elev. 2429 m), Pingwu County, Sichuan, China, 15 August 2016, coll. Manchao Xie. Paratypes. 8 females, the same data as holotype.

Relation to host. The mites are vagrants on the undersurfaces of the leaves, no obvious damage seen.

Etymology. The specific name is from the Latin *hypole* and *us*, *hypole* is derived from the host plant, and *us* is for masculine gender end.

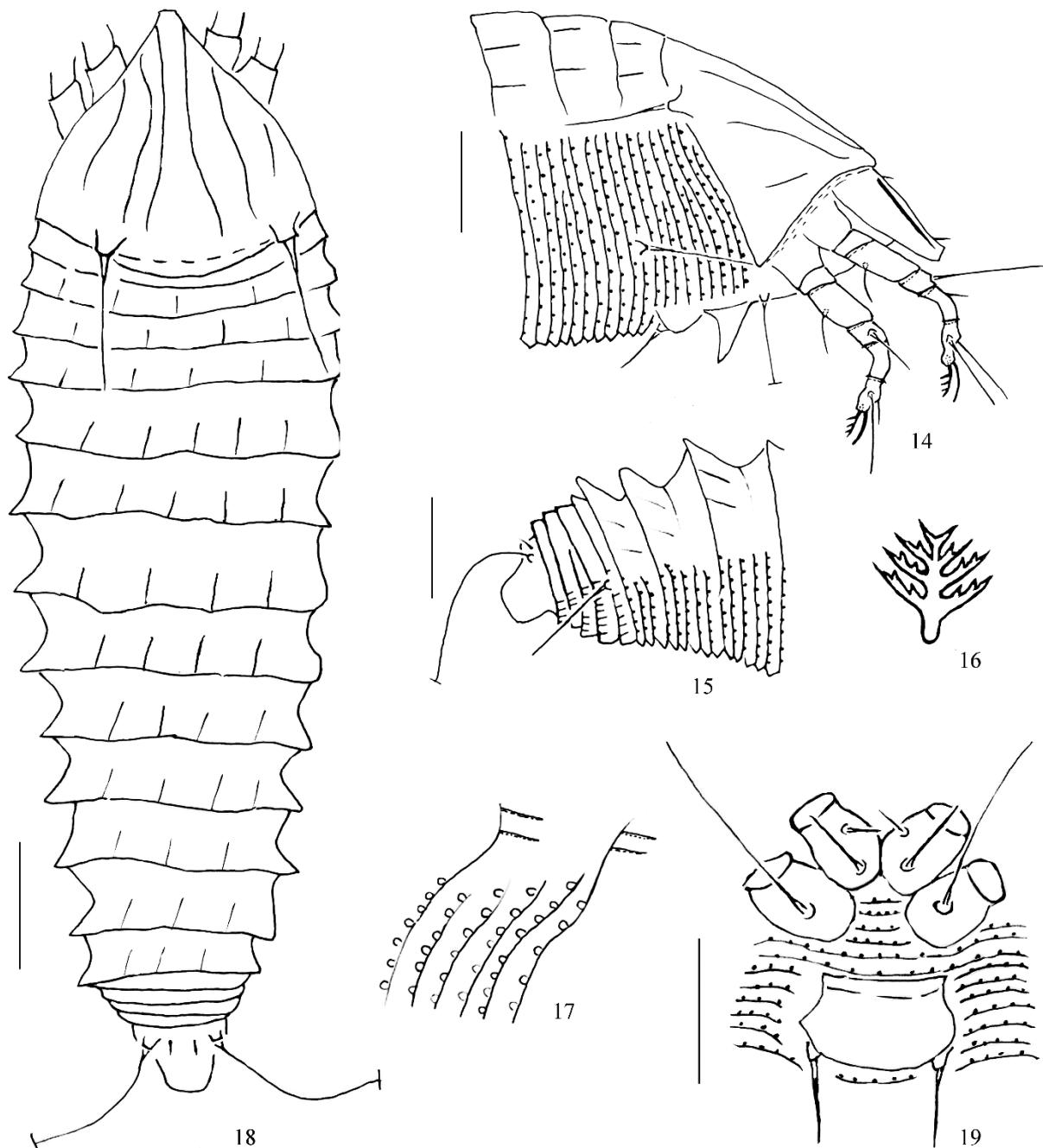
Remarks. The new species is the second eriophyid mites reported from *Maddenia hypoleuca*, besides *Diptacus maddenis* Song, Xue & Hong, 2007 in Heilongjiang and Shaanxi. The new species is characteristic by the H-shaped mark on shield, the 6-rayed tarsal empodium and the long setae 3a. It is similar to *A. shaoxingensis* Kuang, 1998 by the shield design with lines and the coxal plates smooth, but distinguished from the latter by having a round frontal lobe of prodorsal shield, the tarsal empodium 6-rayed and female coverflap with 10 longitudinal ridges, while *A. shaoxingensis* have four thorn addition on frontal lobe of prodorsal shield, tarsal empodium 4-rayed and female coverflap smooth.

***Anthocoptes lindleyanus* sp. nov.** (Figs 14–19)

Diagnosis. Body fusiform, light yellowish in color. Gnathosoma projecting obliquely downward. Prodorsal shield frontal lobe present, median line absent, admedian and submedian lines completed. Scapular tubercles nearby rear shield margin, scapular setae (sc) directing to rear. Coxisternal plates smooth, prosternal apodeme present. Legs with tarsal empodium simple, 4-rayed, tarsal solenidion unknobbed. Opisthosoma with 16–18 dorsal annuli and 57–63 ventral annuli, dorsal annuli sculptured with lines. Female genitalia coverflap smooth.

Description. Female ($n=31$). Body fusiform, 175 (158–175), 60 (50–60) wide, 60 (60–68) thick; light yellowish in color. Gnathosoma 20 (18–20), projecting obliquely downwards; dorsal pedipalp genual setae (d) 3 (3–4), pedipala coxal setae (ep) 2 (2). Prodorsal shield triangular, 36 (35–40), 53 (42–53) wide, with frontal lobe over rostrum base. Shield design with median line absent, admedian and the first submedian lines completed, second submedian lines uncompleted. Scapular tubercles nearby rear shield margin, 20 (18–20) apart; scapular setae (sc) 22 (20–22), projecting to rear. Coxigenital region with 4 (4–6) microtuberculated semiannuli. Coxal plates smooth, anterolateral setae on coxisternum I (1b) 5 (5–6), 9 (5–9) apart; proximal setae on coxisternum I (1a) 12 (11–12), 5 (3–5) apart; proximal setae on coxisternum II (2a) 30 (28–35), 19 (12–19) apart; prosternal apodeme 5 (5–6). Leg I 28 (27–30), trochanter 2 (2), femur 9 (9–10), basiventral femoral setae (bv)

8 (8–10); genu 4 (4), antaxial genual setae (l'') 20 (20–22); tibia 6 (6–7), paraxial tibial setae (l') 3 (3–4), located 1/3 from dorsal base; tarsus 7 (6–7), both setae ft' and setae ft'' 15 (15–17); tarsal empodium (em) 6 (5–6), entire, 4-rayed; tarsal solenidion (ω) 7 (6–7), unknobbed. Leg II 27 (26–28), trochanter 2 (2), femur 9 (9–10), basiventral femoral setae (bv) 8 (8–10); genu 4 (4), antaxial genual setae (l'') 10 (8–10); tibia 5 (5); tarsus 7 (6–7), setae ft' 7 (4–7), setae ft'' 15 (15–17); tarsal empodium (em) 6 (5–6), entire, 4-rayed; tarsal solenidion (ω) 7 (6–7), unknobbed. Opisthosoma with 17 (16–18) dorsal annuli, anterior 13–14 broad dorsal annuli following with posterior 3–4 narrow and thin annuli; ventrally with 63 (57–63) semiannuli, with round microtubercles on rear annular margins except caudal 5–6 ventral annuli with elongated microtubercles. Setae $c2$ 20 (15–20) on ventral annulus 10–11, 49 (34–49) apart; setae d 40 (30–40) on ventral annulus 23–24, 34 (27–34) apart; setae e 13 (12–13) on ventral annulus 39–40, 18 (15–18) apart; setae f 20 (15–20) on 5th ventral annulus from rear, 17 (11–17) apart. Setae $h1$ 2 (2–3), 6 (5–6) apart; setae $h2$ 60 (50–60), 10 (9–10) apart. Female genitalia 12 (10–12), 20 (20–22) wide, coverflap smooth, setae $3a$ 10 (10–11), 15 (12–15) apart.



Figures 14–19. *Anthocoptes lindleyanus* sp.nov., female. 14. Antero-lateral view. 15. Postero-lateral view. 16. Empodium (enlarged). 17. Lateral opisthosoma (enlarged). 18. Dorsal view. 19. Coxal-genital region. Scale bars: 14–15, 18–19=20 μ m.

Male. Unknown.

Material examined. Holotype, female, from *Buddleja lindleyana* Fortune (Scrophulariaceae), Wanglang Nature Reserve (33°54'41"N, 104°09'18"E; elev. 2440 m), Pingwu County, Sichuan, China, 15 August 2016, coll. Manchao Xie. Paratypes. 10 females, the same data as holotype; 20 females, from *Buddleja davidii* Franch. (Scrophulariaceae), Wanglang Nature Reserve (32°57'21"N, 104°07'20"E; elev. 2513 m), 17 August 2016, coll. Manchao Xie.

Relation to host. The mites are vagrants on the undersurfaces of the leaves, no obvious damage seen.

Etymology. The specific name is from the Latin *lindleyani* and *us*, *lindleyani* is derived from the host plant, and *us* is for masculine gender end.

Remarks. This new species is the second eriophyid mites reported from *Buddleja lindleyana* besides *Aculops buddlejae* Xue, Song & Hong, 2010 in Shaanxi.

This species is similar to *A. loricatus* (Nalepa, 1889) by the shield design with median line absent, the coxal plates smooth and the coverpalp smooth. The new species can be differentiated from the latter by the scapular tubercles nearby rear shield margin, the shield design with admedian and the submedian lines completed, while *A. loricatus* has the scapular tubercles set on rear shield margin, the shield design with admedian lines absent and the submedian lines uncompleted.

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